**RELATED RATES OF CHANGE**

We use the Chain Rule { } to relate one rate of change to another rate of change.

**Example 1**: When a stone is dropped into a still pond of water, a circular ripple is formed. The radius of the circle is increasing at 2 m/s. Calculate the rate at which the area of the circle is increasing when the radius is 8m.

* Find:
* Use Chain Rule:
* Since the other variable in the problem is radius(r), the missing term in our Chain rule is .
* Therefore
* We have been given . We need to calculate .
* Since area of a circle is A = , then .
* Rate at which area of circle is increasing = = x 2 = .
* Rate at which area of circle is increasing when the radius is 8 m = = 32 m2/s.

**Example 2**: A rubber hot water bottle is being inflated at a steady rate of 1280 cm3/s. The bottle is spherical, and the formula for the volume of a sphere is V = . Calculate the rate at which the radius is increasing at a time of 1 minute after the bottle starts inflating.

* Find:
* Use Chain Rule:
* Since the other variable in the problem is volume(V), the missing term in our Chain rule is .
* Therefore
* We have been given 1280 cm3/s. We need to calculate .
* Since volume of a sphere is V = , then .
* is the reciprocal of , so = .
* Rate at which radius is increasing = = x 1280 = .
* We need a value of r to substitute into to give us the rate at which the radius is increasing at time t = 1 minute = 60s.
* Since the volume is increasing at 1280 cm3/s, at time t = 60, the volume is 1280 x 60 = 76 800 cm3.
* 76 800 = , so solving this gives r = 26.4cm.
* Therefore the rate at which the radius is increasing after 60 s is = 0.146 cm/s.